Siro KURITA*: **Chromosome numbers and systematic position of the genus *Woodsia*****

栗 田 子 郎*: イワデンダ属の染色体数と系統的位置について

(Pl. XIV)

The genus *Woodsia* includes about thirty species mainly distributed over the temperate zone in the northern hemisphere. Cytologically investigated hitherto are seven species (Manton 1950, Britton 1953, 1964, Mehra and Singh 1955, Meyer 1959, Kurita 1961, Knobloch 1962, Wagner 1963, Löve and Löve 1961, Taylor and Lang 1963, and Sorsa 1963). The gametic chromosome number is found to be 41 or its multiple in five of these species. The rest are *Woodsia glabella* R. Br. (n=39, 2n=78; Meyer, 1959; Britton, 1964), and *W. scopulina* D. C. Eat. (n=38; Wagner, 1963). Meanwhile, Sorsa (1963) described apploximately 82 bivalents in *W. glabella* from Finland, and Löve and Löve (1961) found about 80 chromosomes in somatic cells of the same species.

Two Japanese species, *W. manchuriensis* and *W. macrochlaena* will be dealt with presently. The former species has no articulation on the petiole and shows a rather small, hairless opening that leads to a large spherical indusium. Owing to these characteristics it has been included in an independent genus, *Physematium* (Nakai, 1925) or *Protowoodsia* (Ching, 1940).

Material and Method

W. manchuriensis was collected in Okutama, Tokyo and Antaroma, Hokkaido; *W. macrochlaena* was collected at Togakushiyama, Nagano Prefecture. Young fertile fronds of these species were fixed in 1 : 3 acetic acid-alcohol in about 24 hours, and their root tips were immersed for 2 hours in 0.002 *M* 8-Hydroxyquinoline at 20°C, and washed for an hour under running tap water before being fixed in 1 : 3 acetic acid-alcohol, 5 minutes, and hydrolyzed during an hour's stay in *N* hydrochloric acid solution at 60°C. Manton's method (1950) was applied for preparing slides.

Results

1) *Woodsia manchuriensis* Hook. In many of the spore mother cells of this

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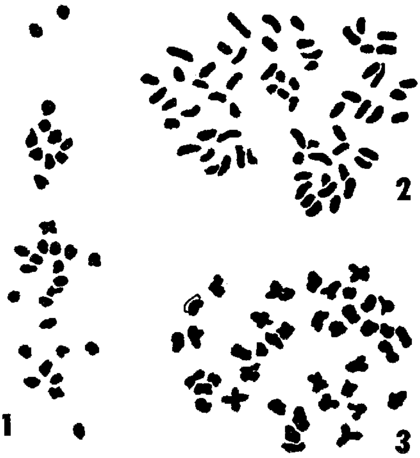
species there were 33 bivalent chromosomes1) in the first meiotic metaphase (Fig. 1), whereas 66 chromosomes were found in the somatic metaphase of root tip cells (Fig. 2). Each of the bivalent chromosomes mesured 2-3μ in length at the first meiotic metaphase. There were sixteen spore mother cells in a sporangium and they developed afterwards into sixty-four bilateral spores. This species therefore is a diploid based on n=33.

2) *Woodsia macrochlaena* Mett. At a late diakinetic stage of this species 41 bivalent chromosomes were distinct (Fig. 3). Each bivalent at this stage is 3-5 μ long. Each sporangium has sixteen spore mother cells which give rise to sixty-four bilateral spores. Therefore this species is also a diploid, based on n=41.

Discussion

Intrageneric division of *Woodsia* has been different with authors. Tagawa (1937) put stress on the presence of articulation on petiole and the morphology of indusium, and divided the genus into four sections, Euwoodsia Hook., Eriosorus Ching, Perrinia Hook., and Physematium Hook. As is evident in Tab. 1, these sections seem to have no definite relation with chromosome numbers; Euwoodsia has two different basic chromosome numbers, 41 and 39; Physematium, 41 and 33; Perrinia, 41 and 38. However, some such relation would be discovered if a farreaching comparative study on morphology were performed.



Figs. 1-3. 1. A spore mother cell of *W. manchuriensis*, showing 33 bivalent chromosomes. × c. 750. 2. Sixty-six chromosomes in a somatic cell of *W. manchuriensis*. × c. 1000. 3. A spore mother cell of *W. macrochlaena*, showing 41 bivalent chromosomes. × c. 750.

Ching (1940) framed genus *Protowoodsia* to include *W. manchuriensis*, for he thought to have found tetrahedral spores in this species, but Copeland (1947) pointed out that the spores in this species are practically bilateral instead of being tetrahedral. Dispite its

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1) This gametic number has also been confirmed by Mitsui (1965).

characteristically definite chromosome number, n=33, this species has no positive reason in gross morphology for being treated as *Protowoodsia*.

Bower (1928) distinguished four genera, *Woodsia*, *Diacalpe*, *Peranema*, and *Hypoderris*, in his Woodsiae, and recent cytological studies have shown x=41 in all but *Hypoderris* whose chromosome number is unknown. In *Woodsia*, however, three other basic numbers have been known. Since one of the basic numbers in *Woodsia*, x=41, is common among many genera in Aspidiaceae (senusu lato) there is a reason for considering Woodsioid ferns closely related to them.

As to phylogeny of Woodsiae there have been arguments. Bower (1928, 1935) pronounced that Woodsiae are derived from Cyatheaceae whose phylogenetic origin would be seeked in Gleicheniaceae. Ching (1940) also assumed "Cya-

Tab. 1. Chromosome numbers in members of different section of *Woodsia*

Sect. Euwoodsia Hook.		
Subsect. Ilvensis Ching		
W. glabella R. Br.	n=39, 2n=78	Meyer (1959)
	n=c. 82	Sorsa (1963)
	2n=c.80	Lvöe and Löve (1961)
	n=39	Britton (1964)
W. alpina Gray	n=c.82	Manton (1950)
W. ilvensis (L.) R. Br.	n=c.41	Manton (1950)
	n=c.41	Britton (1953)
	n=41	Taylor and Lang (1963)
Subsect. Acrolysis Nakai		
W. polystichoides Eat.	n=41	Kurita (1962)
W. macrochlaena Mett.	n=41	Kurita
Sect. Perrinia Hook.		
W. mexicana Fée	n=82	Knobloch (1962)
W. scopulina D. C. Eat.	n=38	Wagner (1963)
Sect. Physematium Hook		
W. elongata Hook.	n=41, 2n=82	Mehra and Singh (1955)
W. manchuriensis Hook.	n=33, 2n=66	Kurita
	n=33	Mitsui (1965)

theaceae -Woodsiaceae" series. Holttum (1949), on the other hand, considered that *Woodsia* originated in "Primitive marginales" and placed it in his Dennstaedtiaceae. Reviewing these theories, Pichi-Sermolli (1959) described that the origin of Cyatheales from the ancestors of modern Gleicheniales is beyond doubt and that Aspidiales including Woodsioideae also originate in Gleichenioid ancestors. Based on cytological data Mehra (1960) disapproved Bower's view. He considered that Woodsiaceae with $x=41$ can not directly be derived from Cyatheaceae which have $n=69$ and $n=70$, though the both groups may have a remote original stock in common as suggested by their close resemblance in gross morphology.

The basic numbers have been known in some members of Gleicheniaceae: $n=20$ and 22 in *Gleichenia*; $n=56$ in *Hicriopteris*; $n=39$, 43 and 78 in *Dicranopteris*; and $n=34$ in *Sticherus*. The known basic numbers in Cyatheaceae are $n=70$ in *Hemitelia* and 69 in *Alsophila*, *Cyathea*, and *Hemitelia*. Comparing these numbers the author considers that 33 and 39 in *Woodsia* suggest affinity with $n=34$ and 39 in Gleicheniaceae and, on the other hand, 70 and 69 in Cyatheaceae may be related to 33 in *Woodsia* and also to 34 and 22 in Gleicheniaceae, since 70 and 69 of Cyatheaceae could have been reduced to 35 and 23 respectively. Nevertheless, the opinion of Holttum (1949) that *Woodsia* have come from *Dennstaedtia* cannot be denied, for the latter also known to have $n=33$.

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イワデンダ属 *Woodsia* では，いままでに7種の染色体数が知られていた。筆者は新たにコガネシダ *W. macrochlaena* で n=41 を，フクロシダ *W. manchuriensis* で n=33 および 2n=66 を観察した。これら9種の内6種が n=41 で，残りの3種，トガクシデンダ *W. glabella*, *W. scopulina*, フクロシダがそれぞれ興味深い染色体数を持っている。表1に示すように染色体数と外部形態に基づく分類系との間は特定の関連は見出し得なかった。

イワデンダ属の系統的位置に関しては多くの論議があるが，一般にはヘゴ科 Cyatheaceae と類縁が深いとみなされている。一方ヘゴ科はウラジロ科 Gleicheniaceae と系統的に近いと考えられている。染色体数から系統を考えてみると，イワデンダ属の n=41はオシダ科の他の属，例えばオシダ属 *Dryopteris*, イノデ属 *Polystichum* などの基本染色体数と一致するので，これらの属と類縁が深いと言えよう。さらにこの属に n=33, n=39 が存在することはヘゴ科 (n=69, 70) やウラジロ科 (n=20, 22, **34**, **39**, 56) との類縁を示唆すると言いたい。

Explanation of the plate XIV

1: A spore mother cell of *W. manchuriensis*, showing 33 bivalent chromosomes. × c. 1500. 2: Sixty-six chromosomes in a somatic cell of *W. manchuriensis*. × c. 2000

正 誤 (Errata)

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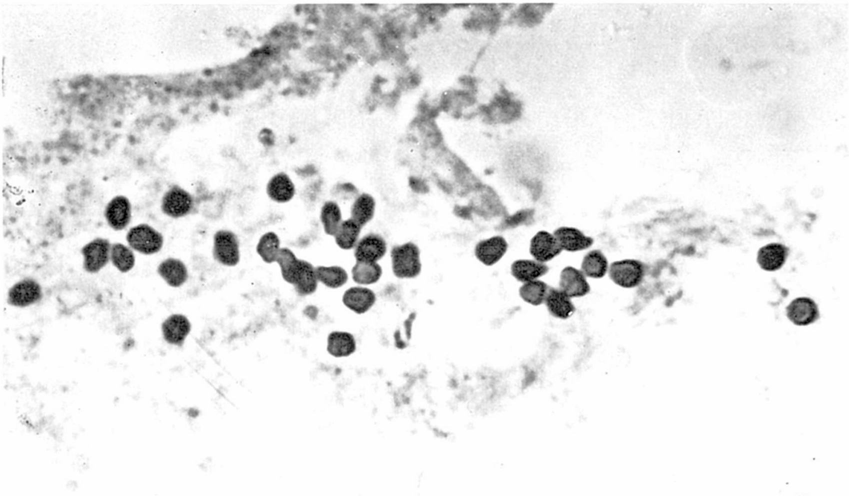

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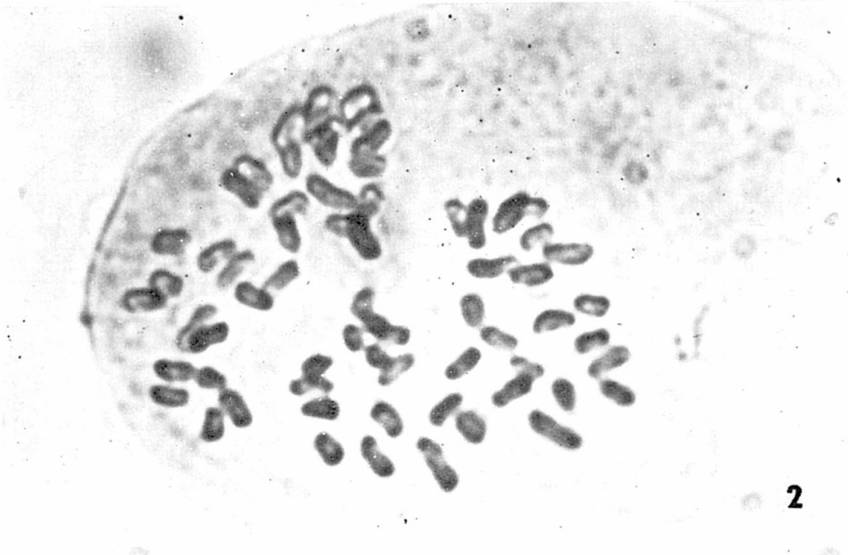

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